ANNALES D'ÉCONOMIE ET DE STATISTIQUE. – N° 47 — 1997

International Enterprises and Endogenous Market Structure

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ABSTRACT. – We propose a model of product differentiation where the strategies of two firms determine not only the market and industry structures but also the direct investment and trade patterns. In this framework, we show that the markets can have a monopoly or duopoly structure according to the trade barriers and the sunk cost levels. When the multinationalization of both firms is achieved, it is always in a prisoner's dilemma game which is Pareto damaging for the firms' profit. Moreover, the leader firm reling on the sunk costs, the direct investments can permit not only a "market pre-emption" abroad but also an "industry" pre-emption" as they lead to prevent the entry of the follower firm on both markets.

Firmes internationales et structure de marché endogène

RÉSUMÉ. – Dans cet article, nous proposons un modèle simple dans lequel les produits sont différenciés et les stratégies de deux firmes déterminent non seulement la structure des marchés et de la branche mais aussi le type inter ou intra-branche des échanges internationaux et des investissements directs. Dans ce cadre, nous montrons que la structure de duopole s'impose à l'équilibre face au monopole lorsque le montant des coûts fixes d'entrée dans la branche et d'implantation à l'étranger ainsi que le niveau des barrières aux échanges sont faibles. Les deux entreprises deviennent toujours multinationales dans un jeu de type dilemme du prisonnier, la firme "leader" s'appuyant sur ces coûts fixes d'implantation à l'étranger pour bloquer non seulement l'entrée de sa rivale sur le marché étranger mais aussi l'accès de celle-ci à l'ensemble de la branche.

* C. MATHIEU: E.R.U.D.I.T.E: Université Paris XII-Val de Marne. This is an abridged version of chapter 2 of my Ph. D. thesis, discussed in September 1993 at the Institut d'Études Politiques de Paris. I am indebted to P. BLANCHARD, J. L. CAYATTE and P. A. MESSERLIN for stimulating discussions and suggestions on an earlier draft. I am also particularly grateful to M. C. ESPOSITO, M. MOTTA, P. SEVESTRE and two anonymous referees for helpful comments. Of course, any remaining errors and omissions are my own responsibility.

1 Introduction

The growing integration of the world economy has been a major phenomenon since the 1980s. This development has been viewed as a consequence of the rapid increase in international trade in goods and services, and of the even more rapid growth of foreign direct investment (FDI) (see E. H. PREEG [1995]). A second development, somewhat paradoxical in the light of the world's economy integration is the expansion of regional groupings in Europe, North America and East Asia (see A. SAPIR [1992]). In this phase of integration-regionalization, multinational enterprises (MNE) have played a major role, trying to achieve world-wide production and to increase their marketing, research and development and financial activities in order to relax the constraints of international competition or even to take advantage of this competition (see D. SALVATORE [1995]).

MNE increasingly perceived as "footloose" often belong to industries where products are differentiated and to markets where competition is imperfect. Product differentiation being a structural component of the markets where the MNE operate, it is likely that these firms will use the choice of the technical specification of their products as a means of limiting national and international competition (see A. SHAKED and J. SUTTON [1984], A. JACQUEMIN [1989]). However, few analyses of the multinational phenomenon have tried to take into account both product differentiation and imperfect competition simultaneously (see B. LYONS [1984], E. HELPMAN and P. R. KRUGMAN [1985] and W. J. ETHIER [1986]). Even though the literature on international trade and multinational firms relies on imperfect competition, it generally assumes an exogenously specified market structure in a context of oligopoly, see for instance A. K. DIXIT [1984] and J. EATON and G. M. GROSSMAN [1986], or in a monopolistic competition framework as in P. R. KRUGMAN [1979], E. HELPMAN [1981] and A. J. VENABLES [1985]. However, more recent contributions (see I. J. HORSTMANN and J. R. MARKUSEN [1987] and J. A. LEVINSOHN [1989]) consider that the market structure may be partially endogenous since, even if the structure of foreign market is initially fixed, it can evolve due to the growth of local demand and the use of an import tariff or a quota by the foreign government. In these recent works, however, foreign local firms are assumed to sell their goods only on their domestic markets and not to react to the pressure of international competition by developing a part of their activities abroad. In fact, the analysis of international competition and market structure remains limited at least in comparison with the growing capacity of MNE to carry competition on a world-wide basis.

Following A. SMITH [1987], A. JACQUEMIN [1989] and M. MOTTA [1992] and [1994] we make explicit use of the game theory to modelize the current MNE's behavior. In this framework, we assume like I. J. HORSTMANN and J. R. MARKUSEN [1992] that market structures together with the structures of international industries are modified by the decisions of the firms, especially, at the level of their internationalization process (export or FDI) and of their potential entry on markets and in industries. Therefore, we propose a dynamic model of oligopoly where the firms' choices determine not only the market and industry structures but also FDI and trade pattern. In our analysis of the firms' behavior, we also consider two other important dimensions of (international) competition that is to say prices and product differentiation.

In a first section, we present the assumptions of our model, especially the dynamics of strategic choices. In a second section, we determine – according to the internationalization and geographical localization strategies – the equilibrium prices and technical characteristics of goods sold in countries. We demonstrate that the presence of important trade tariffs affects the maximal differentiation principle. In others words, the firms do not systematically choose the most important technical distance between their goods in order to enjoy more competition distortion due to high tariffs. In a third section, we focus on the strategic role of the internationalization process, like exports and FDI. From this analysis, we can deduce, on the one hand, the evolutions of market and industry structures and, on the other hand, trade and FDI patterns. Thus, we show that one or two suppliers can be present in the industry according to the technology constraints expressed by the fixed cost level and the size of the different countries. But we also show in our model that the firm which plays first is able to use its position and the FDI strategy to stay alone in the industry. Moreover, markets will have a monopoly or a duopoly structure depending on the tariff level. We also prove the existence of intra-industry trade and cross-hauling FDI, when countries have similar sizes. The fourth section presents concluding remarks.

2 An Internationalization Model with Price Competition and Product Differentiation

We build a model with two countries based on an extension of the spatial approach proposed by H. HOTELLING [1929]. We determine the equilibrium on two markets (one market by country) where domestic and foreign differentiated products can be traded. In our model, the markets can have a monopoly or a duopoly structure. We analyze the firms' behavior using a dynamic game where firms use different strategies over time, taking the choices of their rivals into account.

We assume that consumers consume two types of goods. The first one is homogeneous and is taken as numeraire. The second is differentiated. All consumers have the same income and the same preferences for the homogeneous good. On the other hand, they have different tastes for the differentiated products.

For the differentiated goods, the consumers are located, according to their preferences, on the interval [0, 1] with a uniform density $D_k \, (k = A, B)$.

Note that this density depends on the country/market k considered. At each interval point corresponds a technical specification, i.e. a vector of technical characteristics, of a potential differentiated good. This potential good is the most preferred product for a number D_k of consumers. Then we suppose horizontal product differentiation as defined by K. J. LANCASTER [1975].

More specifically, we consider that each consumer has the following indirect utility function:

$$(1) \qquad V(R,\, \nu_i^k,\, x_i,\, x_p) = R - (x_i - x_p)^2 - \nu_i^k$$

where R is his individual income, x_p a vector of technical characteristics, defined on the interval [0, 1] and corresponding to the most preferred potential good of this consumer. We assume that each consumer buys at most one unit of a differentiated good, the number of differentiated goods supplied being finite. The term $(x_i - x_p)^2$ measures the disutility supported by a consumer when he cannot buy his most preferred good characterized by x_p but buys product i with characteristics vector x_i. The selling price of good i on market k is ν_i^k. This price is specific to each country for two reasons. On the one hand, it is composed not only of the mill price p_i^k but also of a potential tariff (or transport cost) as long as the good i is exported to the country k. This tariff will be noted t_k. On the other hand, the consumers cannot make arbitrages between countries for legal rules and/or geographical distance. Therefore, there is no reason for the prices of a same differentiated good to be equal between markets.

Good i will effectively be bought if,

$$(2) \quad \phi(R,\, \nu_i^k,\, x_i,\, x_p) = \mathrm{Max}\,\{V(R,\, \nu_j^k,\, x_j,\, x_p);\, 0\} \qquad \forall\, x_j \in [0,\, 1]$$

In other words, a consumer will buy good i as soon as the consumption of good i results in a maximum level of indirect utility with respect to other products supplied and as long as the value of this utility function is positive. If expression (1) is negative for all goods i supplied, then the consumer will buy only the homogeneous good (see J. W. FRIEDMAN [1983]). However, we assume an income-inelastic demand. In other words, the income of consumers is high enough so that they can always consume one of the differentiated goods supplied.

The assumptions about the firms' technology are as follows: each firm produces only one good with the technical characteristics x_i. An insufficient demand and the existence of barriers to entry in the industry allow the presence of at most two firms (i = 1, 2). We also suppose, without loss of generality, $x_1 < x_2$ on the interval [0, 1]. Firms are assumed to have the same constant marginal cost of production, that is zero. They incur a positive fixed sunk cost of entry and production, F_{ik}. In the same way, the creation of a production subsidiary abroad has a cost F_{ik}^{ID} which is also assumed to be fixed and sunk. The presence of this cost can be justified for two distinct reasons: the transfer of specific factors by the firm towards its plant abroad, such as assets obtained from research and development, and the entry on the foreign market (see I. J. HORSTMAN and J. R. MARKUSEN [1987] and [1992]).

Finally, as we assume the absence of consumer arbitrage between markets, we suppose that firms are able to segment markets. Thus, they have the opportunity to charge different prices across countries.

The equilibrium on both markets depends on the firms' strategies and on the value of their objective functions. The dynamic-sequential game we build develops in three stages. In the first stage, the firms decide whether to enter the industry or not, on the geographical localization of their production and on their internationalization process. More precisely, both firms make a choice over four options: a) no entry, referred to as the zero localization strategy; b) serving only the domestic market from one plant, referred to as the one-domestic localization strategy; c) serving both the home and foreign markets from one plant, referred to as the one-export localization strategy; d) or becoming a MNE by FDI and the setting up of plants in both countries, referred to as two-localization strategy. In stage two, both firms choose the technical characteristics of their goods. In these first two stages of the game, decisions are taken sequentially, i.e. each firm knows perfectly well the choice of its rival when it decides to maximize its profit. Thus in the sub-game corresponding to these two stages information is perfect. This hypothesis is justified because these decisions have sufficiently visible consequences (plant building) or a sufficiently long duration (the launch of a new product) so that each competitor is informed about the choices of its rival. These decisions imply irrevocable commitments. Therefore, in each stage each firm makes choices once for all and does not adjust ex post with respect to the decisions of the other firm. In the last stage of the game, both producers play a one-shot BERTRAND-NASH game where moves are assumed to be simultaneous. The game is solved backwards in the usual fashion (see R. SELTEN [1975]). Then the perfect NASH equilibrium in pure strategies is obtained by solving the plant localization that maximizes the firms' profits, knowing the equilibrium prices and the optimal technical characteristics of products.

The profit functions of both firms depend on the demand for each product. Consumers will choose good i if the obtained utility $V(.)_i$ is higher than the utility they would get with the consumption of good j, $V(.)_j\,(i \neq j)$. In this context, all consumers located on the interval $[0,\, \hat{x}^k_{1,2}]$ (respectively on $[\hat{x}^k_{1,2},\, 1]$) will address their demand to firm *1* (respectively to firm *2*). $\hat{x}^k_{1,2}$ corresponds here to the technical characteristics vector that is most preferred by the consumers who are indifferent between purchasing good *1* or good *2*, given prices ν^k_1, ν^k_2 and the technical characteristics vectors x_1, x_2. Then $\hat{x}^k_{1,2}$ is,

(3) $$\hat{x}^k_{1,2} = \frac{\nu^k_2 - \nu^k_1}{2\,(x_2 - x_1)} + \frac{x_2 + x_1}{2}.$$

Therefore, good i's demand $(i = 1,\, 2)$ on he market $k\,(k = A,\, B)$, with $x_1 < x_2$, is such that,

(4a) $$Q^k_1 = D_k\, \hat{x}^k_{1,2}$$

(4b) $$Q^k_2 = D_k\,(1 - \hat{x}^k_{1,2})$$

Note that $\hat{x}^k_{1,2}$ has a continuous derivative on the interval [0, 1]. The demand function of good i on the market k is then continuous and decreasing with respect to the price ν^k_i. Using equations (4a) and (4b), the profit functions are given by,

$$\text{(5a)} \qquad \Pi_1 = \sum_{k=A,\,B} p^k_1\, D_k\, \hat{x}^k_{1,\,2} - e_1\,[(1-b_1\, m_1)\, F_{1A} + b_1\, F_{1B}]$$

for firm *1*, while for firm *2*, it is.

$$\text{(5b)} \qquad \Pi_2 = \sum_{k=A,\,B} p^k_2\, D_k\,(1-\hat{x}^k_{1,\,2}) - e_2\,[(1-b_2\, m_2)\, F_{2A} + b_2\, F_{2B}]$$

According to the localization strategies of firms, the market structure will be modified in the same way as the conditions of competition. The prices paid by consumers are different depending on the good being domestic or imported. Thus, $\nu^A_i = p^A + b_i\, m_i\, t_A$ and $\nu^B_i = p^B + m_i\,(1-b_i)\, t_B$, where $b_i = 1$ if good i is produced in country B (and possibly exported to market A) and 0 otherwise. Moreover, $m_i = 1$ if firm i only owns one plant and $m_i = 0$ if its production is located in both countries. Then, the two dummies, b_i and m_i, indicate the localization strategies of firms. These dummies are likewise associated with fixed costs because production conditions can be different between countries and a plant abroad involves an additional sunk cost. Finally, the zero-localization strategy is expressed by the dummy e_i. This dummy is equal to 1 if firm i is present in the industry and equal to 0 otherwise.

As shown in table 1, the combination of localization strategies leads to consider 6 cases. In the first case, the duopolists use together a one-localization strategy and are located in the same country A or B. In the second case, both firms also use a one-localization strategy but their plants are not present in the same country. In the third case, one firm only has a one-localization strategy, the other one having a two-localization strategy. In the fourth case, both firms use together a two-localization strategy. In the last two cases, one of the firms has a zero-localization strategy. Then this firm chooses not to enter the industry, $e_i = 0$.

These different localization strategies can lead the firms to sell their products abroad via exports or foreign affiliates. Then we can deduce the pattern of international trade from these different strategies. In table 1, trade can be unilateral (first and fifth cases) or intra-industry (second case) whether the firms produce in the same country or in different countries. The pattern of FDI can also be deduced from our model. Thus cross-hauling (or intra-industry) FDI can appear in the fourth case where, both firms own a plant abroad. As a result, multinationalization is total. Trade and FDI can also be present together. But in this context of partial multinationalization, only one firm is a MNE, its rival being an exporter. Indeed, at the firm's level, production abroad an exports are exclusive to each other. Each firm is monoproduct and its marginal cost is not striclty increasing. Therefore, it is not profitable to keep a domestic production for exports when an affiliate produces abroad (see T. Horst [1973]). Finally, firms may prefer not to be international at all and to use a one-domestic localization strategy rather than a one-export localization strategy. Consequently, there is neither trade nor FDI. Both countries are then in autarky, the firms choosing to be alone on their domestic markets in order to exploit their monopoly rents.

TABLE 1

Firm Localization and Trade Flows Corresponding

		Plant Localization		Trade pattern
1st Case		firm 1	firm 2	
$b_1 = b_2$	A	1 or 0 (*)	1 or 0	Unilateral trade flows
$m_1 = m_2 = 1$	B	0 or 1	0 or 1	
2nd Case		firm 1	firm 2	
$b_1 \neq b_2$	A	1 or 0	0 or 0	Intra-industry trade or absence of trade
$m_1 = m_2 = 1$	B	0 or 1	1 or 0	
3rd Case		firm 1	firm 2	
	A	1 or 1	1 or 1	
	B	1 or 0	0 or 1	Partial multinationalization (**) and unilateral trade flows
$m_1 \neq m_2$				
	A	1 or 0	0 or 1	
	B	1 or 1	1 or 1	
4th Case		firm 1	firm 2	
$b_1 = b_2$	A	1	1	Total multinationalization (**) and absence of trade
$m_1 = m_2 = 0$	B	1	1	
5th Case		firm 1	firm 2	
$e_i = 1$	A	1 or 0	0 or 0	
$m_i = 1$	B	0 or 1	0 or 0	Unilateral trade flows
$e_j = 0$ $(i \neq j)$	A	0 or 0	1 or 0	
	B	0 or 0	0 or 1	
6th Case		firm 1	firm 2	
$e_i = 1$	A	1 or 0	0 or 1	
$m_i = 0$	B	1 or 1	0 or 1	Total multinationalization and absence of trade
$e_j = 0$ $(i \neq j)$				

(*) The value 1 (respect, 0) is associated with the existence (respect, with the absence) of firm i's plant in country k. In each case, the first (second) column of firm 1 must be coupled with the first (second) column of firm 2. Thus, in the first case both firms are located in country A (first column) or in country B (second column).
(**) We consider that multinationalization is total when both firms own an affiliate abroad. Multinationalization is partial if only one firm produces in both countries.

3 Tariff and Price and Technical Characteristics Equilibria

Given the hypotheses of the model and the game progress described above, we must first work out the equilibrium solutions concerning prices and technical characteristics in order to obtain a perfect NASH equilibrium. By assumption each firm is able to set a different price on each market because markets are segmented and variable costs are zero, hence separable between countries. The application of the first order conditions on profit functions (5a) and (5b) leads to the following synthetic solutions (under the positive price hypothesis) [1]:

(6a) $$p_1^{A^*} = \max\left\{\frac{(m_2\,b_2 - m_1\,b_1)\,t_A}{3} + \frac{x_2^2 - x_1^2}{3} + \frac{2\,(x_2 - x_1)}{3};\,0\right\}$$

(6b) $$p_2^{A^*} = \max\left\{\frac{(m_1\,b_1 - m_2\,b_2)\,t_A}{3} - \frac{x_2^2 - x_1^2}{3} + \frac{4\,(x_2 - x_1)}{3};\,0\right\}$$

on the market A, and on the market B,

(7a)
$$p_1^{B^*} = \max\left\{\frac{[m_2\,(1-b_2) - m_1\,(1-b_1)]\,t_B}{3} + \frac{x_2^2 - x_1^2}{3} + \frac{2\,(x_2 - x_1)}{3};\,0\right\}$$

(7b)
$$p_2^{B^*} = \max\left\{\frac{[m_1\,(1-b_1) - m_2\,(1-b_2)]\,t_B}{3} - \frac{x_2^2 - x_1^2}{3} + \frac{4\,(x_2 - x_1)}{3};\,0\right\}.$$

These equations show that the presence of a tariff can substantially modify the equilibrium solutions according to the different localization strategies of the firms. This first conclusion is largely confirmed by the results presented below.

A Same Localization of Firms: No Competition Alteration via Tariffs (1st and 4th Cases)

In the first case where both firms own one plant in the same country (i.e. $b_1 = b_2$ and $m_1 = m_2 = 1$), equations (6) and (7) show that the tariff does not modify the equilibrium prices and profits. If both goods

1. It is not necessary here to check the second order conditions because the profit functions are concave with respect to prices. This result is deduced from the demand function concavity, variable costs being zero.

are exported, the tariff has the same effect on prices and on the demand functions. Then the tariff does not distort price competition abroad, no firm being at a disadvantage with respect to its rival due to this tariff. In the same way, it is easy to show that the tariff does not distort quality competition between both firms. Therefore, as in the case of a closed economy, the equilibrium leads to the maximal product differentiation, the optimal choice for both firms, being $x_1^* = 0$ and $x_2^* = 1$. Note that this last result would be the same if both firms decided upon the technical characteristics of their goods simultaneously.

We obtain identical results in the fourth case when both firms are MNE (i.e. $b_1 = b_2$ and $m_1 = m_2 = 0$). Indeed, as shown by equations (6) and (7), prices are independent of the tariff. Moreover, product differentiation is maximum. However, there is a noteworthy difference with the first case. The tariff is here jumped rather than suffered.

B Different Localizations of Firms: A Limited Competition Due to The Tariff

We consider here the two following cases: a) 2nd case where firms are localized in different countries; b) 3rd case where only one firm is a MNE. The distinction is necessary because optimal prices are now different in each case; competition conditions are modified as firms use a different localization strategy.

a. One firm by country (2nd case, $b_1 \neq b_2$ and $m_1 = m_2 = 1$)

In this second case, both firms choose either a one-domestic localization or a one-export localization. Consequently, two sub-cases must be considered. In the first one, we have intra-industry trade and each market has a duopoly market structure. In the second sub-case, there is no trade. Then, both countries know an autarky situation and markets have a monopoly structure.

1. Intra-industry trade and the duopoly structure of markets

The equilibrium prices deduced from equations (6) and (7) show the two opposite effects of a tariff on prices. A tariff protects the domestic firm from foreign competition. Then, it has a positive effect on the price of the domestic product. Conversely, the tariff increases the price of the imported foreign product and has therefore a negative impact on its price. The intra-industry trade implies that both firms sell their products on both markets. Then, they are confronted with the two opposite effects of the tariff and the price equilibrium is not symmetric on each market. Moreover, the equilibrium price of good i when it is exported, p_i^l, is always lower than its equilibrium domestic price, p_i^k. Indeed, we have $p_i^k = p_i^l + \frac{t_i + t_k}{3}$ for $k \neq l$. This result confirms the principle of reciprocal dumping as a consequence of trade protection (see J. BRANDER and P. R. KRUGMAN [1983] and J. GUAL [1987]).

Trade protection can challenge the equilibrium linked to the maximal differentiation of products. For some values of a sufficiently high tariff ($t > 1.63$ for a same tariff in the two countries), both firms choose a technical specification of their products such as $x_1^* > 0$ or/and $x_2^* < 1$. This result can be proved on the basis that the maximum of at least one of the profit functions has an interior solution on the interval of technical characteristics. Therefore, the tariff can reduce price competition together with quality competition. In fact the first mover chooses, before his rival, to challenge maximal differentiation. Such a behaviour allows him to enjoy the reduction in competition.

Moreover, trade protection can also modify the market structure that shifts from duopoly to monopoly. High tariff levels can lead to a negative profit derived from exportations or even to optimal prices that are undefined for some values of x_2 strictly geater than x_1 [2]. In this context, international competition is no longer profitable. High tariffs prevent exports and forbid the entry of firms on the foreign market. therefore, firms are monopolies on their respective domestic markets and countries experience an autarky situation.

2. Autarky and the monopoly structure of markets

Even if each firm is the sole supplier on its domestic market, it does not fully behave as a monopolist in so far as a threat exists from the importer. It cannot set the price of its product at a level that would give the importer the opportunity to make a positive profit. Due to the foreign firm's behavior, each domestic market becomes contestable in the way defined by W. J. BAUMOL, J. C. PANZAR and R. D. WILLIG [1988]. Nevertheless, note here that market contestability is not perfect. The tariff is a barrier to entry for the foreign firm, even if it does not support any other additional exporting cost.

Therefore, if both firms are the only suppliers on their respective domestic markets, equilibrium prices are now,

$$\text{(8a)} \quad \tilde{p}_1^k = \operatorname{Min}\{t_k^2 + (x_2^2 - x_1^2) - 2\,(x_2 - x_1);\ R - \operatorname{Max}(x_1^2;\ (1 - x_1)^2)\}$$

$$\text{(8b)} \quad \tilde{p}_2^l = \operatorname{Min}\{t_l^1 - (x_2^2 - x_1^2);\ R - \operatorname{Max}(x_2^2;\ (1 - x_2)^2)\}$$

The prices $\tilde{p}_1^k = t_k^2 + (x_2^2 - x_1^2) - 2\,(x_2 - x_1)$ and $\tilde{p}_2^l = t_l^1 - (x_2^2 - x_1^2)$ are determined in two stages. First, the selling prices of the imported goods are just equal to the amount of tariffs, i.e. $\nu_2^k = t_k^2$ and $\nu_1^l = t_l^1$, the importers' prices (p_1^l and p_2^k) being then zero. Secondly, prices $\tilde{p}_1^k$ and $\tilde{p}_2^l$ are fixed so that the domestic market can be cleared by domestic firms. In other words, since by hypothesis demand is income-inelastic, firms set prices so as to equal the reservation prices of the most distant consumers on the basis of technical characteristics. Here, each domestic market is contestable though it has a monopoly structure. Indeed, even if each local firm can achieve a market pre-emption, it is constrained in its price determination, $\tilde{p}_i^k$, by the potential entry of its foreign rival.

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2. In assuming without loss of generality that good *1* is exported on market A, the expression $-\frac{t_A}{3} + \frac{x_2^2 - x_1^2}{3} + \frac{2\,(x_2 - x_1)}{3}$ deduced from equation (6a) is negative for positive values of t_A, more precisely for $t_A > x_2^2 - x_1^2 + 2\,(x_2 - x_1)$.

When $\tilde{p}_i^k = R - \mathrm{Max}\,(x_i^2;\,(1-x_i)^2)$, both domestic markets are uncontestable in so far as there is no impact of foreign competition on the optimal price determination. The expression $R - \mathrm{Max}\,(x_i^2;\,(1-x_i)^2)$ is obtained by assuming, as previously, that firm i clears its domestic market.

From expressions (8a) and (8b), we can deduce the new profit function of firm i,

$$\text{(9)} \qquad \tilde{\Pi}_i^k = \mathrm{Min} \left\{ \begin{array}{c} D_k\,(t_k^j + \alpha_i\,(x_2^2 - x_1^2) - 2\,\beta_i\,(x_2 - x_1)) \\ D_k\,(R - \mathrm{Max}\,(x_i^2;\,(1-x_i)^2)) \end{array} \right\} - e_i\,F_{ik}$$

where $\alpha_1 = \beta_1 = 1$, $\alpha_2 = -1$ and $\beta_2 = 0$.

In this case, on each market maximal differentiation is never an equilibrium. However, we do not get the same equilibrium with contestable or uncontestable markets. In the presence of contestability, the firm moving first chooses any technical specification of its product on the characteristic interval [0, 1] and its rival, the second mover, reacts by taking the same technical specification for its own good.

Assume without loss of generality that firm *1* is the second mover and is a monopoly on market B. It is easy to show that $\tilde{p}_1^B = t_k + (x_2 - x_1)\,(x_2 + x_1 - 2)$ will be the optimal price of good *1* if $x_1^* = x_2$. This last expression is the reaction function of firm *1* to the technical choice of firm *2*. From this reaction function, we can deduce $\tilde{p}_2^A = t_A^2$. Therefore, firm *2*'s maximal profit is independent of its choice about the technical specification of its good. This result is explained because only firm *2*, as first mover, is able to impose its choices on its rival.

When markets are uncontestable, both monopolies always choose an identical specification that is now unique and is the middle of the interval [0, 1]. We have $x_1^* = x_2^* = \frac{1}{2}$ since each market must be cleared by hypothesis. Then, the consumers that are most distant of x_i^* on market k enjoy the same minimum level of satisfaction by purchasing good i. Thus as in the price determination process, the first mover does not impose its technical choices on its rival when markets are not contestable.

b. An asymmetric or partial multinationalization (3rd case, $m_1 \neq m_2$)

In this case, where each of the rivals owns a plant on the domestic market k, the tariffs have no effects on prices and profits. The price equilibrium obtained is then the same as one would get if the firms used identical localization strategy. Conversely, in the foreign country l where only one firm owns a plant, equilibrium prices and profits can depend on the tariff. The MNE's competitor can either be an exporter or no exporter. Therefore, in order to determine equilibrium prices on market l, we use equations (6), (7) or (8) according to the one-localization strategy of the MNE's rival. As before, high values of the tariff can lead to a negative profit of exportations. Consequently, the tariff is able to determine the presence or the absence of trade and the monopoly or duopoly structure of the foreign market l.

In this third case, the maximal differentiation does not hold when the MNE's competitor is an exporter: protection introduces competition distortion to the benefit of the MNE since only the exporter supports an additional cost due to the tariff. Thus, for a same tariff t and identical consumers' densities D in both countries, product differentiation is no longer maximal if $t > 1.218$. In fact, only the MNE is induced to challenge the maximal differentiation since, with its plant abroad, it can jump the trade barriers. Then, this firm could supply a good with the medium technical characteristics of the market (i.e. $x_i^* \to \frac{1}{2}$). In the opposite, the MNE's rival looks for the maximal technical distance for its good (i.e. $x_j^* = 1$) whatever t's level in order to limit its disadvantage due to the tariff. Here, the different sizes of both countries, expressed by consumer densities, can favor the absence of products' maximal differentiation. Indeed, if the foreign market l has a greater size than the domestic market k, competition asymmetry is increased, the exporter seeing its total export cost rising.

In the same way, product differentiation is not maximal when the MNE's competitor uses a one-domestic localization strategy. In this case, as the MNE is a monopoly on the foreign market, it is incited to choose a technical specification of its product close to $\frac{1}{2}$. In fact, we can show that product differentiation will be maximal only if the size of domestic country k is twelve times that of foreign country l. Moreover, one can easily prove that the technical specification of the MNE's product is equal to $\frac{1}{2}$ as long as $D_k \leq 2\,D_l$. Note that this result also holds when only one firm is an exporter (1rst case). Indeed, in this case both firms can use a different localization strategy even if they produce in the same country.

c. No plant localization for one firm and sunk cost (5th and 6th cases)

In both these cases, one of the firms uses a zero-localization strategy. In other words, just one firm, defined as the incumbent, is in the industry. As costs are assumed to be sunk they imply the commitment of the incumbent that can thwart entry of the second firm on both markets. Due to barriers to entry, only one firm is present in the industry and markets are not contestable. In this framework, the incumbent firm is able to be an exporter or a MNE. If the monopoly is a MNE, the optimal price and the technical specifications of the product are the same as if this monopoly would sell its good on one uncontestable market only. Then, equilibrium prices are deduced from expressions (8) and optimal technical characteristics are such as $x_i^* = \frac{1}{2}$. We get the same results for the optimal domestic price and technical specification of the product when the monopoly is an exporter. On the other hand, the optimal foreign price must now take into account the tariff applied abroad. Therefore, we have $\tilde{p}_i^l = R - t_l^i - \mathrm{Max}\,(x_i^2;\,(1-x_i)^2)$.

The previous development shows how tariff protection can limit international price and quality competition. Thus, in the presence of intra-industry trade or partial multinationalization between countries the prices of domestic goods rise and products become closer substitutes. In the same way, tariff protection can reduce competition by preventing imports. Beside trade barriers, we have shown that entry barriers can also exist due to the presence of sunk costs. We are now going to analyze how the relative level of these different barriers can determine the optimal localization strategies of firms. These optimal strategies make up the perfect NASH equilibrium and for this reason create not only trade or multinationalization patterns but also market structures together with the number of firms in the industry.

4 Trade, Multinationalization and Endogenous Market Structure

At this stage of the game, the localization strategies are chosen sequentially, by assumption. Firm i, moving first, chooses whether to enter the industry or not, its geographical localization between countries and its internationalization process (exports or FDI) before its rival makes such decisions. Moreover, the optimal localization strategies leading to the perfect NASH equilibrium depend on the optimal strategies concerning prices and technical specifications of products. Then, it is advisable to use the profit functions determined in the previous section and to keep only the highest ones for each firm according to the parameter values of the model and the strategies of the other supplier.

With the six cases considered previously we have been able to determine the optimal profits in terms of prices and technical specifications according to the different localization strategies of firms. These different profit functions are summarized in table 2. In the first and second cases, both firms export. However, as seen previously their plant localization is the same in the first case whereas it is different in the second one. In the next case multinationalization is partial. In sub-case (3a), firm *1* owns an affiliate abroad whereas its rival exports. In (3b) the situation is inverted, firm *2* being a MNE. In the fourth case is when both firms are MNE. In the two following cases, only one firm is in the industry. Note that the unique firm can export (5) or owns a plant abroad (6). In order to highlight the autarky situations, we have kept the seventh and eighth cases where both firms are monopolies on their respective domestic markets. As we have shown these markets are contestable (7) or uncontestable (8). Finally, in the last two cases, only one firm is international. If this international firm is a MNE, we get the profit functions in (9) and if it exports in (10). We will see that both these cases do never correspond to perfect equilibria. However, we have kept them in table 2 since for different parameter values of the model they lead the firms to choose their localization strategies in a prisoner dilemma framework.

In order to analyze how the entry and trade barriers modify the perfect NASH equilibrium, i.e. trade and multinationalization patterns and market structures, we take different values of fixed costs and tariffs. In the same way, we consider different income levels because these can change trade patterns and market structures. Finally, as the relative size of the countries is able to modify the perfect NASH equilibrium, we also consider that consumer densities can be different across markets.

TABLE 2

Functions of Optimal Profit in Prices and Technical Specifications According to the Localization Strategies

(1)	(2)
$\begin{pmatrix} D\,\frac{(1+\gamma)}{2} - F_{1\,k} \\ D\,\frac{(1+\gamma)}{2} - F_{2\,l} \end{pmatrix}$	$\begin{pmatrix} \frac{D}{2}\left(\left(1+\frac{t}{3}\right)^{2}+\gamma\left(1-\frac{t}{3}\right)^{2}\right) - F_{1\,k} \\ \frac{D}{2}\left(\left(1+\frac{t}{3}\right)^{2}+\gamma\left(1-\frac{t}{3}\right)^{2}\right) - F_{2\,l} \end{pmatrix}$

(3) (a)	(3) (b)	(4)
$\begin{pmatrix} \frac{D}{2}\left(\gamma+\left(1+\frac{t}{3}\right)^{2}\right) - (F_{1\,k}+F_{1\,l}) \\ \frac{D}{2}\left(\gamma+\left(1-\frac{t}{3}\right)^{2}\right) - F_{2\,l} \end{pmatrix}$	$\begin{pmatrix} \frac{D}{2}\left(\gamma+\left(1+\frac{t}{3}\right)^{2}\right) - F_{1\,k} \\ \frac{D}{2}\left(\gamma+\left(1-\frac{t}{3}\right)^{2}\right) - (F_{2\,l}+F_{2\,k}) \end{pmatrix}$	$\begin{pmatrix} D\,\frac{(1+\gamma)}{2} - (F_{1\,k}+F_{1\,l}) \\ D\,\frac{(1+\gamma)}{2} - (F_{2\,l}+F_{2\,k}) \end{pmatrix}$

(5) (a)	(5) (b)
$\begin{pmatrix} \gamma\,D\,(R-\frac{1}{4}) + D\,(R-\frac{1}{4}-t) - F_{1\,k} \\ 0 \end{pmatrix}$	$\begin{pmatrix} 0 \\ \gamma\,D\,(R-\frac{1}{4}) + D\,(R-\frac{1}{4}-t) - F_{2\,l} \end{pmatrix}$

(6) (a)	(6) (b)
$\begin{pmatrix} (1+\gamma)\,D\,(R-\frac{1}{4}) - (F_{1\,k}+F_{1\,l}) \\ 0 \end{pmatrix}$	$\begin{pmatrix} 0 \\ (1+\gamma)\,D\,(R-\frac{1}{4}) - (F_{2\,l}+F_{2\,k}) \end{pmatrix}$

(7)	(8)
$\begin{pmatrix} Dt - F_{1\,k} \\ \gamma\,Dt - F_{2\,l} \end{pmatrix}$	$\begin{pmatrix} D(R-\frac{1}{4}) - F_{1\,k} \\ \gamma D\,(R-\frac{1}{4}) - F_{2\,l} \end{pmatrix}$

(9) (a)	(9) (b)
$\begin{pmatrix} 0{,}34\,D + \gamma D\left(R-\frac{1}{4}\right) - (F_{1\,k}+F_{1\,l}) \\ 0{,}18\,D - F_{2\,l} \end{pmatrix}$	$\begin{pmatrix} 0{,}18\,D - F_{1\,l} \\ 0{,}34\,D + \gamma D\left(R-\frac{1}{4}\right) - (F_{2\,k}+F_{2\,l}) \end{pmatrix}$

(10) (a)	(10) (b)
$\begin{pmatrix} 0{,}34\,D + \gamma D\left(R-\frac{1}{4}-t\right) - F_{1\,k} \\ 0{,}18\,D - F_{2\,k} \end{pmatrix}$	$\begin{pmatrix} 0{,}18\,D - F_{1\,k} \\ 0{,}34\,D + \gamma D\left(R-\frac{1}{4}-t\right) - F_{2\,k} \end{pmatrix}$

The term γ characterizes the size differences between markets/countries ($\gamma > 0$). Profit functions (9) and (10) are calculated, assuming that markets are not too different in size. Remember that in this case, the MNE or exporting firm chooses the optimal technical specification of its product such as $x_i^* = \frac{1}{2}$.

A Intra-industry Trade or Cross-hauling Direct Investment: Similarity Conditions Concerning Production Costs and Market Sizes

With markets of equal sizes, identical production costs and trade barriers, both firms never produce in the same country, as long as they use the same one-localization strategy. Choosing different one-localization strategies, competitors would be led to lower their profits. Then, both firms export and thus create intra-industry trade. However, as we have seen in the previous section, tariff barriers reduce market access and then limit competition. In this context, both firms can prefer to be monopolies on their respective domestic markets rather than export their products abroad. However, with symmetric tariffs between countries, we establish that the autarky situation can be an equilibrium even if firms are able to become MNE by adopting two-localization strategies. Therefore, the rivals do not systematically make FDI in order to jump tariffs, they can also choose to stay on their respective domestic markets. This result generalizes the conclusion of S. P. ANDERSON, M. P. DONSIMONI and J. J. GABSZEWICZ [1989] namely that under oligopoly, autarky is preferable to international trade for all firms if both countries are identical in terms of the number of firms and the size of demand. However, this result does not hold if the product differentiation is vertical (see MOTTA [1994]). In this case, the firm which produces the up-market product is always better off when it sells its product abroad.

Moreover, firm i is the only supplier that can be alone in the industry. The advantage of this firm is explained by two elements: a) it is the first to enter the industry; b) its decision has a commitment value in so far as its market exit is not anticipated by its potential rival. Therefore on the basis of this first mover advantage, firm i is "leader" and firm j is "follower". Moreover, the equilibrium where the leader is a monopolist on both markets will be reached effectively if it is sustainable with respect to potential competition and profitability objective.

It is now advisable to determine market structures and trade patterns more precisely. In fact, according to the values of fixed cost F and tariff t, there are at most 6 possible equilibrium situations. The different equilibria obtained in terms of F and t are represented in figures 1 and 2. When the consumers' income is equal to 1.75 monetary units, monopoly is the dominating market structure at equilibrium. Note that it is possible to take R sufficiently high to forbid a duopoly equilibrium and, therefore, intra-industry trade or cross-hauling FDI. The equilibrium prices of domestic monopolies can be such as they compensate for losses resulting from no trade or no FDI on the foreign markets.

In fact, two equilibrium groups are opposed depending whether firm i can prevent the entry of its potential competitor in the industry or not. Thus the non-linear frontier, delimiting areas (2), (4), (7), (8) and (5), (6), allows to establish such a distinction [3].

3. Each area defined here has the same number as the corresponding profit functions in table 2.

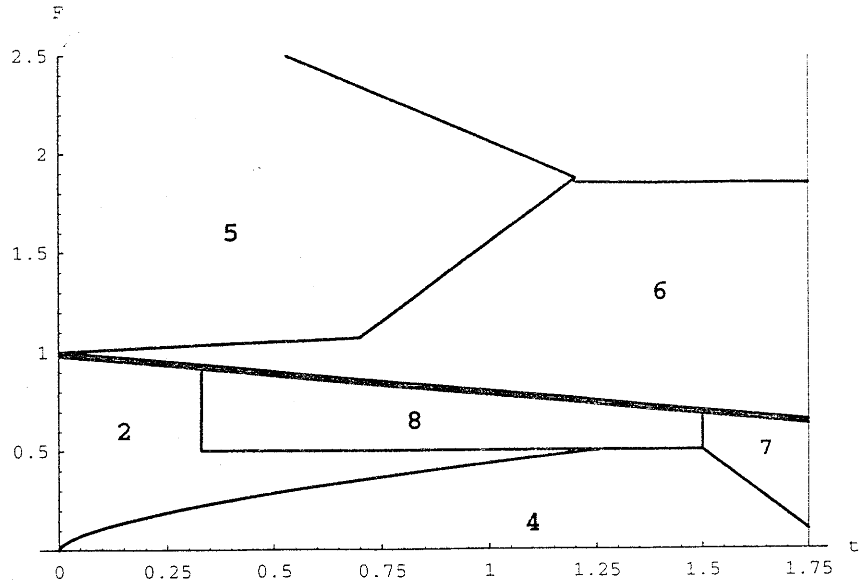

FIGURE 1

***The Different Possible Equilibria with Countries of Same Size and Identical Fixed Cost and With a Consumers' Revenu,* $R = 1.75$.**

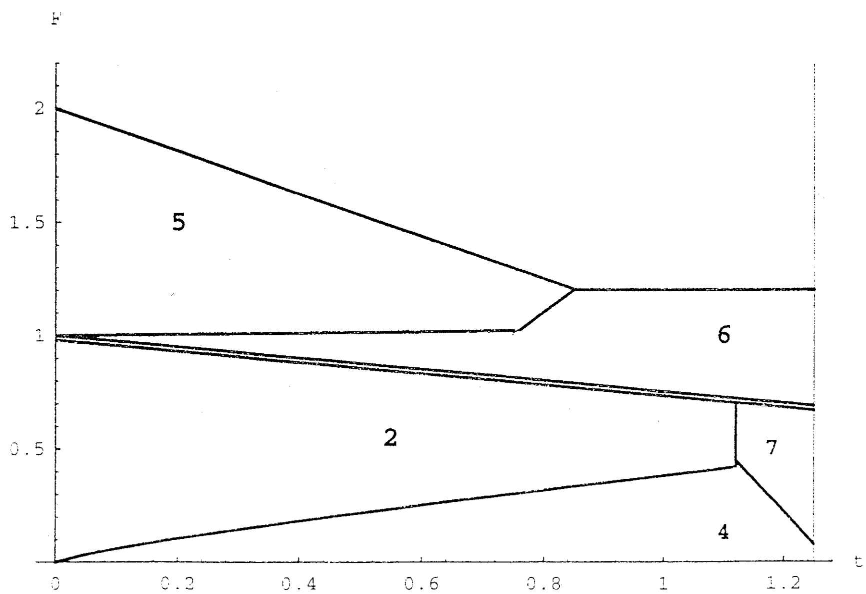

FIGURE 2

***The Different Possible Equilibria with a Consumers' Revenu,* $R = 1.25$.**

Above the frontier, firm j cannot react to the choice of its rival, entering the industry and exporting. Fixed costs and tariffs are too high to obtain a positive profit. Moreover, with sunk costs firm j does not hope the exit of the incumbent i. For areas (2), (4), (7) and (8), strategy choices are determined with respect to competition constraints. Thus for areas (7) and (8), both firms choose to be monopolies on their respective domestic markets since each of them benefits from doing so. For areas (2) and (4), the logic is somewhat different since we now face a prisoner dilemma game (see table 3A). Let us assume that firm i maintains its decision not to become international, selling its goods only on its domestic market. Its rival will then be induced to export or to create a plant abroad. Firm i can no longer remain a monopoly on its own market because its potential profit decreases drastically (see (9) and (10) in table 2). Therefore, it must export or become a MNE, its rival using the same strategy. Here the prisoner's dilemma is effective since from the payoffs/profits structure, we have for example $(9\mathrm{a}) \geq (7) \geq (4) \geq (9\mathrm{b})$ for firm i and $(9\mathrm{b}) \geq (7) \geq (4) \geq (9\mathrm{a})$ for the firm j, the other possibilities of payoffs satisfying of course the same properties. Here, as they become MNE, both firms use optimal two-localization strategies that are systematically Pareto damaging.

TABLEAU 3A

Prisoner's Dilemma Strategies of Domestic or International Sales

	NI	IN
NI	(7) or (8)	(9) or (10)
IN	(9) or (10)	(4) or (2)

TABLEAU 3B

Prisoner's Dilemma Exports and Multinationalization Strategies

	EX	ML
EX	(2)	(3)
ML	(3)	(4)

In the first payoffs bi-matrix, each producer must choose between the one-domestic localization strategy, selling its good only on its domestic market (NI) and one of the other localization strategies, becoming international in selling its product abroad (IN). In the second payoffs bi-matrix, both firms must decide on their internationalization mode. Then they use either the one-export localization strategy (EX) or the two(multi)-localization strategy (ML).

For areas (5) and (6), firm i is the only producer in the industry. It supplies the foreign market with exports (5) or with an affiliate (6) according to the obtained profit. In both cases, this firm discourages the entry of its potential rival. However, the creation of a plant abroad enables it to reinforce the existing barriers due to the fixed sunk cost of entry and production F. As area (5) is above area (6), the level of F deterring entry has to be higher when firm i exports and is not a MNE. Therefore, FDI has not only a 'market pre-emption', as it allows to crowd out the potential competitor on the foreign market, but also an 'industry pre-emption' as it leads to prevent entry on both markets. We generalize the conclusions formulated by I. J. HORSTMANN and J. R. MARKUSEN [1987] and M. MOTTA [1992] on the strategic role of multinationalization on the only foreign market. Moreover, the presence of a MNE in the industry is not subordinated to the condition that subsidiary costs F^{ID} are lower than entry and production costs F [4]. This result is important because of its implications. Firm i can be a MNE even if the transfer cost of its specific factors is higher than their creation cost. Thus, the presence of easily transferable specific factors is not a necessary condition for multinationalization when trade barriers exist, as in this situation. Our result is a limitation to the argumentation developed by S. HYMER [1960] and C. P. KINDLEBERGER [1969] who justify the localization of firms abroad by the transferability of such specific factors between parent companies and affiliates.

Let us now assume that consumers have a lower income than before, with $R = 1.25$ monetary units. Then, the equilibria evolve differently in terms of F and t with regard to the previous situation (see figure 2). In fact, the decrease in consumers' income reduces firm i's ability to become the only supplier in the industry (areas (5) and (6)) or a monopoly on a contestable market (area (7)). However, the frontier delimiting areas (5) and (6) is not affected by the importance of consumers' income, unless t exceeds R. Moreover, note that the equilibrium where both firms are monopolies on uncontestable market disappears: it is replaced by two existing equilibria with a duopoly market structure. The first equilibrium corresponds to intra-industry trade (area (2)) and the second one to total multinationalization (area (4)). As the consumers' income gets lower, the surplus that is captured by each monopoly decreases. Therefore, the fall in monopoly rents makes trade opportunities more attractive despite the constraints of international competition.

The equilibrium with intra-industry trade is never obtained from a prisoner's dilemma framework unless it is profitable for one firm to become a monopoly on its domestic market. In the opposite, the equilibrium with total multinationalization (area (4)) is always the solution of a prisoner's dilemma game (see table 3B). For small values of the tariff (i.e. $t \leq 1.14$), the comparison of profit functions gives for firm $i\ (3a) \geq (2) \geq (4) \geq (3b)$ and for its rival $j\,(3a) \geq (2) \geq (4) \geq (3b)$. If firm i chooses to export, then its competitor is led to create an affiliate abroad. However, this pattern of partial mutlinationalization (with unilateral trade) will not be better for firm i than the case where it owns a plant abroad. Therefore at equilibrium, for fixed costs relatively low with respect to tariffs, a pattern of total multinationalization exists at the expense of a pattern of intra-industry trade. M. CASSON and G. NORMAN [1983] obtain the same result even if their analysis is limited to only one market. The robustness of this result is confirmed by M. MOTTA [1994] who finds the same conclusion in a vertical product differentiation model with two countries and two international firms. Nevertheless, the prisoner's dilemma can appear in an another situation that is not highlighted by these three authors. For higher tariffs (i.e. $t > 1.14$), firm i is not always guaranteed of a contestable market, area (7). The other firm with low subsidiary costs can be induced to jump the trade barriers. Consequently, firm i benefits from becoming a MNE like its rival.

4. Here we have assumed that $F^{ID} = 0.66\,F$. Higher subsidiary costs would not modify the frontier below areas (5) and (6), but would reduce the size of area (6).

Concerning, product differentiation, one can observe that it is always maximal for small tariff values (i.e. $t \leq 1.14$) when both firms are present in the industry. In other words, we confirm thus the result obtained previously, namely that high tariffs distort competition via the technical specifications of products. However, maximal differentiation also depends on low amounts of fixed costs and of consumers' income since they prevent monopoly market structures and a supply of weakly differentiated products. Furthermore, the multinationalization of both firms seems to be determined only by the arbitrage between technology constraints, expressed by fixed costs (as variable costs), and trade barriers, a high level of tariffs favoring FDI (see I. J. HORSTMANN and J. R. MARKUSEN [1992]). However, the tariff also introduces a distortion in competition via the choice of technical characteristics that can be favourable to exports and unfavourable to FDI. Thus, the substitution between exports and FDI is well explained in our model by tariffs but with two distinct and opposite channels.

We assume here that firms share the same fixed costs and that countries have identical sizes and apply the same tariffs. These three hypotheses result in an indeterminate specialization of countries although there is a leader and there is a follower in the industry. In other words, when the pattern of intra-industry trade corresponds to an equilibrium we cannot determine in which country each good is produced since it is indifferent for firm i to produce in one or the other country. We have the same indeterminacy for the FDI pattern. The subsidiary creation by firms in country A or B has no influence upon their profits. Then, we cannot really identify in which country the subsidiary is created and, nor can we determine the pattern of FDI. The indeterminacy on countries' specialization can be removed if both countries have different sizes.

B Different Market Sizes, Unilateral Trade and Partial Multinationalization

Assume arbitrarily, but without loss of generality, that $D_A \geq D_B$. A first result appears straightaway. Firm i will always benefit from entering on market A as it has the largest size, its rival being able to choose the same localization strategy or another one according to the tariff level. However, this result does not hold when at least one of the two suppliers is a MNE. In this case, the geographical location of plants is indifferent for each firm. Therefore, despite the hypothesis of different market sizes, indeterminacy persists for the FDI pattern. This indeterminacy will be removed if we assume that competitors do not face the same production conditions in each country, i.e. $F_{ik} \neq F_{jk}$. In fact, this hypothesis is strictly equivalent to the assumption that an autarky equilibrium exists before the countries are opened to international trade and FDI, and firms are not "footloose".

Both markets now having different sizes, the equilibrium situations are modified (see figures 3, 4 and 5). Thus, we no longer have markets with an uncontestable monopoly structure [5]. On the contrary, two new possible equilibria appear. The first one is related to partial multinationalization in the industry with exports between countries. In the second one, both firms export from the same country. In its choices, firm j must take the relative level of tariff into account with respect to consumer density on market A. In fact, if $0 < t \leq \frac{\sigma(\gamma-1)}{\gamma+1}$ where $\gamma > 1$ is a proportionality factor between consumers' densities, the tariff is sufficiently low to incite firm j to take advantage of the size of market A. In the opposite, for $t > \frac{\sigma(\gamma-1)}{\gamma+1}$, it locates in country B, since the decrease in competition offsets the attractive character of market A. In a free trade context (i.e. $t = 0$), the country size does not modify firm j's behavior since it obtains the same profit whatever its plant location. These conclusions are of course partial since we do not take into account the other possible equilibria. Therefore, it is advisable to determine the realizable equilibria according to different values of γ.

In contrast to the case where the countries have the same size, two new equilibria can appear for the three values of γ considered (i.e. $\gamma = 1.1$; 1.3; 1.6). Thus area (1) corresponds to the situation where both firms produce

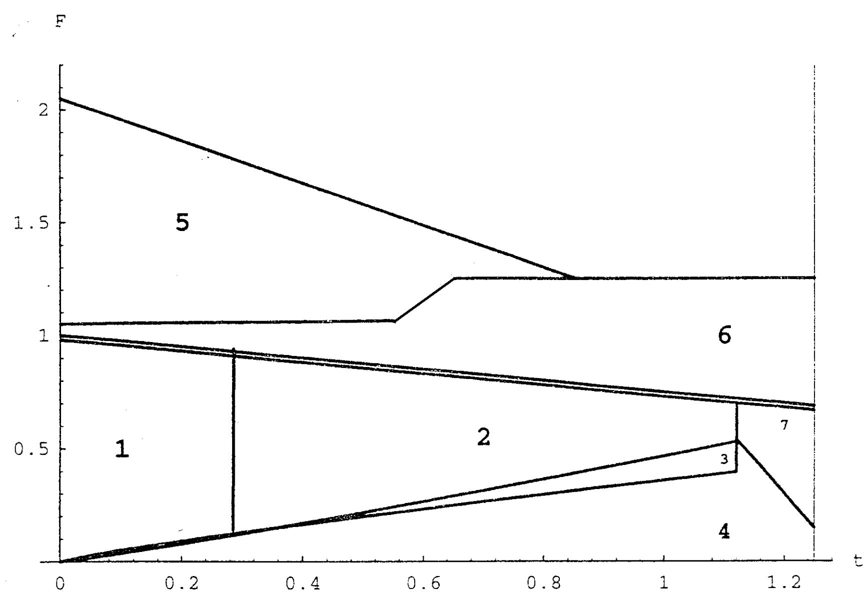

FIGURE 3

The Different Possible Equilibria with Countries of Different Sizes, $D_A = 1.1\, D_B$, and With a Consumers' Revenu, $R = 1.25$.

5. This result is also largely due to the assumption concerning the income level ($R = 1.25$). With higher income, the equilibrium with uncontestable markets could again appear.

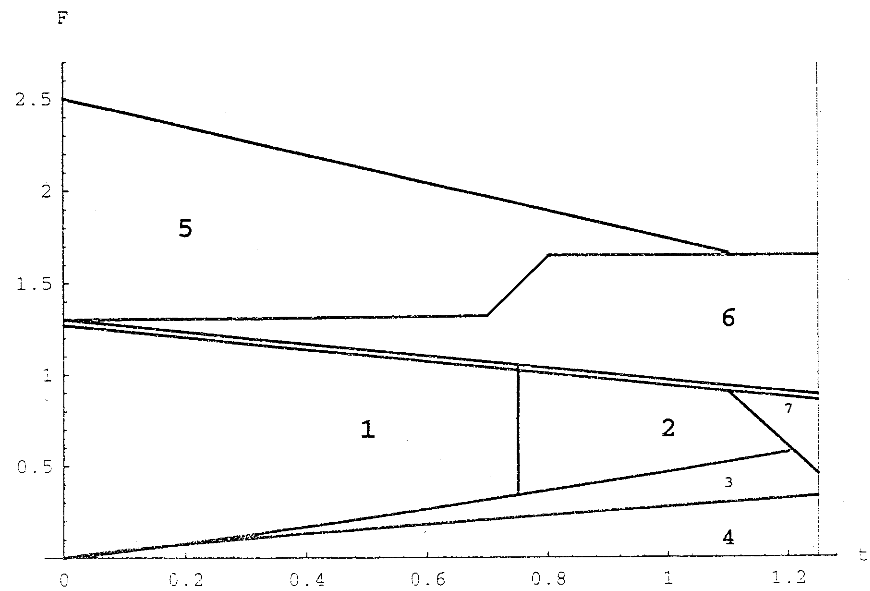

FIGURE 4

The Different Possible Equilibria with Countries of Different Sizes, $D_A = 1.3\,D_B$***, and With a Consumers' Revenu,*** $R = 1.25$***.***

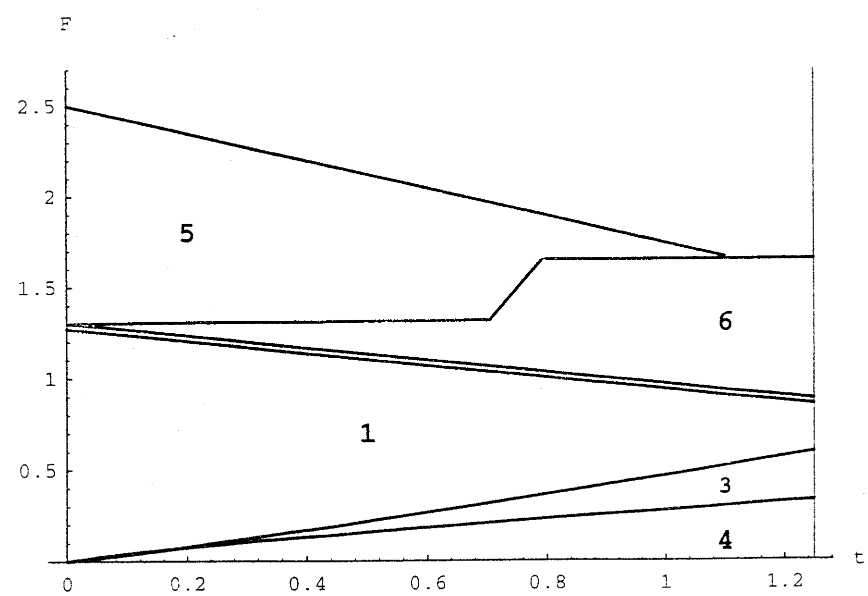

FIGURE 5

The Different Possible Equilibria with Countries of Different Sizes, $D_A = 1.6\,D_B$***, and With a Consumers' Revenu,*** $R = 1.25$***.***

in country A and export on market B. The partial multinationalization is the second equilibrium, area (3). This second equilibrium is not obtained in a prisoner's dilemma game contrary to the case of total multinationalization (area (4)). In this case, for different combinations of tariffs and fixed costs, firm i is not better off when it exports since its rival, becoming a MNE, reduces its profits. Therefore in area (4), firm i creates a subsidiary abroad. However, as countries are now different in size it tariffs are sufficiently low in comparison with fixed costs, it is profitable for both rivals when firm j exports instead of making FDI. Therefore, the equilibrium with partial multinationalization is not obtained from a prisoner's dilemma framework.

The increasing size of country A leads to reduce the combinations of F and t for which an equilibrium exists with contestable markets. This result is well explained since as γ increases, it becomes difficult for a firm to maintain a monopoly on market A even if it is contestable. Then, international trade is favored. However, trade flows are unilateral from country A to B since the tariff is no longer a proper means to reduce the pressure of international competition. In the extreme case where $\gamma = 1.6$, an intra-industry trade equilibrium exists only with free trade. Moreover, there is no equilibrium with contestable markets.

The frontier delimiting the number of suppliers in the industry is modified too. The more different the market sizes, the higher the capacity of firm j to enter the industry despite high fixed costs. In fact, the increase in γ reduces competition between firms. But at the same time, areas (5) and (6), where firm i is alone in the industry, move up and their surface increases. Therefore, the leader like its (potential) competitor benefits from a higher demand in comparison with the initial situation where $D_A = D_B$. We would also like to emphasize that it is still not necessary to assume that the entry and production costs are higher than the subsidiary costs so that a partial or total multinationalization exists at the equilibrium.

As previously, the maximal differentiation does not always hold at the equilibrium. But it is systematically present when trade and entry barriers are low. In this respect, we can note that for $t \in [1.21, 1.25]$, firm i as a MNE does not practise the maximal technical distance vis-à-vis its exporting rival. This phenomenon is more marked as the size of market A increases. In the case of partial multinationalization, only firm j pays a tariff. Therefore, the distortion of competition introduced by trade protection is favorable to firm i which is then induced to choose a technical product specification close to the middle of the technologies' interval.

5 Conclusion

Some concluding remarks can be drawn from the study of the internationalization of firms which oporate in a world of two open economies where the location of production is not fixed by the autarky situation. The duopoly equilibrium on each market appears for a wide range of fixed sunk costs and tariffs even if the values of these combinations must not be too high. Therefore, fixed sunk costs and tariffs do not necessarily constitute insuperable barriers to international trade and to market entry. However, for relatively important fixed sunk costs of entry in the industry and of subsidiary creation, only one supplier in the industry corresponds to an equilibrium. As internationalization is used by firms in a strategic way, the sole supplier relies on sunk costs in order to limit not only domestic competition but also international competition. Both firms can also decide to become monopolies on each market. In fact, this last equilibrium must be considered if the consumers' income is high. In this case, the amount of the consumers' surplus captured by each monopoly is sufficient so that it turns away from exports and FDI. In this framework, product differentiation is not always maximal. Firms use the technical specifications of their product as a means to distort competition to their benefit, especially with important tariff protection or entry barriers on markets. In the extreme, consumers can even see the number of goods supplied decrease.

The intra-industry trade equilibrium appears as very sensitive to the variations in the consumers' income and to the relative size of countries. As we have said, high income discourages firms' exports and so prevents intra-industry trade. Moreover if countries have different sizes, both firms produce in the biggest country, which leads to unilateral trade rather than to intra-industry trade. This result is perfectly consistent with the conclusions of the literature on international trade. On the other hand, a less common result is that total multinationalization corresponds to an equilibrium obtained in a prisoner's dilemma framework which is Pareto damaging for the firms' profit. In this game, the alternative strategies to multinationalization can be exportations or no trade. Firms become MNE since the tariff level cannot secure a monopoly position on their respective contestable market. In an equilibrium where both firms are MNE, cross-hauling FDI can be achieved. This last result shows that cross-hauling FDI and intra-industry trade may be exclusive, as it is the case for production abroad and exports. However, it is necessary for both countries to have similar sizes. Otherwise, two elements go against such a substitution: a) the equilibrium where both exporting firms locate their production in a different country disappears as mentioned above; b) partial multinationalization with unilateral trade between countries also becomes a possible equilibrium which replaces total multinationalization.

Following M. MOTTA [1994], we have also been able to show that a cost advantage over the local competitor is not at all a necessary condition for a firm to produce abroad. The first mover advantage, conferred to the leader firm by its commitments as regards the internationalization process and the technical specifications of its product, is also an important explanation element of FDI. Therefore, such a result limits the generality of the conclusions of the dominant theories on the multinational firm (see for instance S. HYMER [1960] and C. P. KINDLEBERGER [1969]) and accounts for the current increase in FDI flows as a firms' reaction to a strengthening of international competition due to the growing integration of the world economy.

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